

New Models for Value Creation and Competitive Advantage in the Petroleum Industry

by

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Summary

This research project has applied, tested and further developed a set of new models for the analysis of value creation and competitive advantage in the context of the global petroleum industry. The basic idea behind the project was that Porter's value chain model (1985) for the analysis of firm-level competitive advantage was basically only applicable to manufacturing. Building on Thompson's (1967) distinction between long-linked, intensive and mediating value creation technologies, we proposed three distinct generic value configurations for the analysis and management of firm-level value creation across industries and firms (see Stabell and Fjeldstad, 1998; Fjeldstad and Stabell, 1997). Each configuration has a distinct activity template and different drivers of firm performance. Thus, while the value chain is proposed as relevant to the analysis of manufacturing firms relying on a long-linked technology, the value shop is an activity template for firms that use an intensive technology and create value by resolving unique customer problems. The value network is an activity template for firms that use a mediating technology and that create value by enabling direct and indirect exchanges across a set of customers.

The major results of the work can be grouped into three main areas: further development of theories and methods, empirical studies, and impact on research, teaching and practice. While our empirical studies are focused on the petroleum industry (primarily petroleum exploration), the other categories of results span a much broader range of issues and industries.

The work has already spawned significant work both nationally and internationally. The best national example is the work on "A Value Creating Norway" (see Jakobsen et al, 2000). This study presents an innovative analysis of clusters integrating the Porter Diamond (1990) and value configuration theory. The telecom industry has been another sector for theory development and application (Fjeldstad, 1999). A recent international textbook (Afuah and Tucci, 2000) has value configuration theory as a pivotal element in the analysis of strategy for the new Internet economy.

Our work has had to contain a significant dose of model and concept development. Simply stated, the value chain concepts turned out to be less articulated and less easy to operationalize than initially envisaged. In part this is due to that the value chain concept is mainly a very broad, generic framework that had as one key hallmark that it has been designed to be applicable to all industries and all firms.

Initially the ideas were developed for the firm-level analysis. In three different analyses of downstream gas, the heavy oil industry and the upstream petroleum industry on the Norwegian Continental Shelf we show that the concepts of industry analysis also need to be revised and adjusted.

The complete set of models and methods for the analysis of competitive strategy and competitive advantage define what we now label as value configuration theory. Value configuration theory builds on and extends Porter's initial work on competitive strategy and competitive advantage (1980, 1985). Our work in this project and related work in other sectors has clarified the need to consider industry analysis (Porter, 1980) and firm analysis (Porter, 1985) as two highly interrelated issues. Industry structure mirrors value creation logic. Recognizing alternative value configurations has spawned an understanding of the existence of different competitive logics in respectively manufacturing, mediation and problem solving service industries. Application of value configuration theory to the petroleum industry has focused and stimulated efforts to further clarify key concepts. Much work remains to be done. We note, however, the need to look at how referral, partnering and interconnection networks in mediation and problem solving service industries structures competition and cooperation. Other main conceptual results are:

- Value configuration must be linked to the business (revenue) model. Our initial ideas concerning hybrid configurations should rather be interpreted as forming the basis for analysis of corporations. Each business unit has a distinct value configuration. To the extent that strategic business units do not focus a primary value configuration then effective strategic positioning is difficult to achieve.
- The concept of drivers is at the core of value configuration theory. Porter's (1985) initial formulation is comprehensive from an application perspective, but conceptually not very well defined. We propose that drivers be defined as structural properties of activities (or the relationship between activities) that shape activity level cost behavior and differentiation contributions (Sheehan, 2000). Drivers need to be activity focused and effective strategic positioning requires considering the interplay of multiple drivers.

The central empirical effort of the project has been a detailed study of reputation as a differentiation driver in petroleum exploration shops (Sheehan, 2000). Exploration is framed as a value shop that solves the "problem" of finding commercial quantities of petroleum. Exploring the hypothesis that reputation is a key driver of differentiation in value shops,

the study develops key contributions in terms of both the theory (see above) and its application to petroleum exploration. The empirical results using data from 62 North Sea exploration units (40 in the UK and 22 in Norway) support the hypothesized relationship between reputation and performance. This result holds even when controlling for size. Data collected as part of the study provides a rich backdrop and benchmark both for further research and for application of value configuration analysis to petroleum exploration.

The data from our study of exploration shops also provides an excellent reference for the analysis of other value shops in both the petroleum industry and other sectors. At the same time petroleum exploration is a particular type of value shop as appropriation of a significant share of the value created requires that the shop own the acreage where petroleum is found. Asset ownership affects governance structures. Petroleum exploration is seldom organized as an independent strategic business unit. Most of the exploration outfits sampled in our study were organized as support activities relative to the primary business model related to the sale of petroleum products.

Our work has had the global petroleum industry as its application focus. This industry provides a rich and in many ways a complex setting for developing and analyzing the implications of the distinction between the different value configurations.

We show that one can take two perspectives on the different segment of the upstream petroleum industry – with important implications for strategy. In the first view, upstream petroleum E&P is an industry of petroleum producers (i.e. a manufacturing industry), where prospective assets are traded freely. The alternative view is that upstream E&P is a problem solving industry, where petroleum E&P companies are solving the problem of finding and exploiting petroleum resources for the asset owner (typically national governments). In the one case, firms generate their revenue from the sale of petroleum. In the other case the petroleum E&P firms are paid (most often in petroleum) for their exploration and exploitation service to the asset owners. We argue that competitive advantage in the manufacturing industry with efficient markets both for petroleum assets and for petroleum at the wellhead is based on differential expectations. Competitive advantage in petroleum E&P problem solving service industry is based on reputation.

The work has significant implications for issues such as effectiveness, alliances and internationalization. The most fundamental is that we need to differentiate approaches and strategies across sectors according to type of sector or where the sector is situated in the larger value system. Equally

important, tools for analysis of both firms and industries are strongly interrelated.

The good news for applied strategy analysis is that there are a finite number of alternative models to consider. We still believe that there are only 3 basic models with associated activity templates: the value chain, the value shop and the value network.

Analysis for competitive advantage, however, is not necessarily much easier after we have introduced the three alternative value configuration models. Although the alternative models provide a good basis for a first order understanding of value creation and business logics, effective application is challenging. This should not come as a surprise as effective strategy cannot be easy to define and achieve as the strategy otherwise would be easy to imitate.

One of the requirements for effective application is a rich repertoire of benchmark templates that can help bootstrap analyses and assist in interpreting results. Our empirical work on petroleum exploration provides a first systematic basis for this type of work in petroleum exploration.

Perhaps most promising in terms of results is that we have identified a broad range of issues for further research. Many are commented on in the different chapters of this report and the underlying research reports. Among the more important issues that relate to petroleum exploration is the need for research that documents the dynamics of differentiation drivers. Our work (Sheehan, 2000) has documented the link between exploration success and reputation. We need more empirical work to understand how reputation affects future performance. As a result of our work this research can start from a sounder conceptualization and measurement basis for both reputation as a differentiation driver and exploration success as a differentiation measure.

We have suggested that firm analysis and industry analysis are strongly interrelated. There is a need for more research on improving the models and methods for the analysis of problem solving industries. And value configuration theory needs to be developed so that it also covers corporate strategy in settings where corporations can be composed of business units that are both homogenous and heterogeneous in terms of type of value creation technology.

1. Introduction

The dominant paradigm for the analysis of firm-level competitive advantage in the strategy literature the last 10 years has been the value chain model developed by Michael Porter (1985). The basic idea is that competitive advantage cannot be understood or managed by looking at the firm as a whole. It is necessary to consider the myriad of activities that the firm does in the process of creating value for its customers. The value chain is here a simple activity template that can be used to identify, represent and analyze value activities.

The value chain framework, however, is more than an activity template. It includes a couple of important conceptual distinctions, one being between primary and support activities. Primary activities are those that create value for the customer. Support activities support the primary activities and therefore only affect customer value indirectly.

The other key concept in Porter's value chain framework is the notion of drivers. Strategic positioning for competitive advantage involves understanding and playing on the drivers of activity cost behavior and differentiation generated by activities. Drivers, such as scale, capacity utilization and location, are key determinants of firm performance. By definition they both determine costs and differentiation. Product differentiation in turn impacts what the customer is willing to pay for the firm's products. The distinction between cost and differentiation drivers maps nicely into Porter's competitive strategy (1980) proposition that there are in reality only two generic strategic positioning alternatives for a firm: cost leadership or differentiation.

Research Project

The basic purpose of this research project has been to explore and apply a set of new models for the analysis of value creation and competitive advantage in the context of the global petroleum industry. In the process we have also uncovered both the need and the potential for further development and extension of the models.

Our simple idea was that the value chain model is appropriate for the analysis of traditional manufacturing, but not so for the analysis of mediation services (such as telecommunication, transportation and banking) and problem solving services (such as consulting, health care, law, architecture). Using Thompson's distinction between long-linked, intensive and mediating technologies (1967), we (Stabell & Fjeldstad, 1998) proposed that there are

three basic value creation technologies and developed two additional models, the value network and the value shop, as analytical templates for the analysis and development of competitive advantage.

We return to the issue in more detail in the next chapter, but let us immediately briefly mention that the alternative value creation models are not only related to different activity templates. More significant, the templates capture the essence of different business logics. And most important for competitive advantage and competitive positioning, the different value creation technologies have a different focus in terms of drivers. The value chain focuses attention on cost drivers, the value shop focuses attention on differentiation drivers, while the value network requires attention to the parallel effect of drivers of differentiation and cost.

The application to upstream petroleum seemed quite evident, as petroleum exploration was one of the concrete examples that had been used to motivate and formulate the value shop model as a distinctive value configuration. In some sense, this project has been an effort to further develop that proposition.

As has become even more clear through subsequent work in this and related projects, the value chain logic has also shaped Porter's framework (1980) for the analysis of competitive advantage at the industry level. Thus while a 5-forces analysis is used to determine the attractiveness of an industry and possible competitive strategies for firms in the industry, then value configuration analysis is used to diagnose and formulate how a specific firm can achieve a position of sustainable competitive advantage in the industry.

Methodologies

The research has relied on a variety of research methodologies. Some of the work is purely conceptual, although we have constantly striven to make effective use of examples and cases from the petroleum industry. The main empirical effort has been focused on petroleum exploration. Here we have collected data both through a survey and from public sources for the analysis of all exploration units active in both Norway and the UK (see Sheehan, 2000). We have also performed focused case investigations of the Canadian Heavy Oil industry, the European gas mediation industry and a few cases involving more in depth analysis and interviews from a limited number of firms involved in petroleum exploration and exploitation. The details of the research methodologies used are documented in the relevant research papers and notes.

Outline

The rest of the report is organized as follows. Chapter 2 is a brief up-to-date summary statement of the key ideas concerning value creation and value configurations that motivated this study. The chapter also discusses some of the lessons learned from the research and application of what we have labeled value configuration theory. In chapter 3 we present our conceptual and empirical results for the industry level analysis, applied and illustrated in the context of the petroleum industry. Chapter 4 presents our conceptual and empirical results for the firm-level analysis, here almost exclusively focused on petroleum exploration. Chapter 5 summarizes the main results and contributions of the study and outlines potentially interesting avenues for further research.

Chapters 3 and 4 are written so that they can be read relatively independently from the rest of the report and from each other. Their format and style emphasizes implications for the practitioner in the petroleum industry. Given that many of the key concepts from the field of strategy that the work builds on are not broadly known or understood in the petroleum industry, we necessarily spend some time setting the stage and motivating the strategy foundations of the work. There is also some repetition of key concepts from value configuration theory across chapters 2, 3 and 4.

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2. Value Configuration Theory

Value configuration theory builds on, extends and transforms Porter's value chain framework (1985) for the analysis and development of competitive advantage. The theory was initially motivated by problems in applying the value chain activity template to firms selling services. The theory is now also linked not only to firm-level analysis of competitive advantage, but also to the analysis of industries and competitive strategies.

Value configuration theory rests on the same ideas that motivated the value chain framework (Porter, 1985). The basic premise is that competitive advantage cannot be understood by looking at the firm as a whole. Competitive advantage stems from the many discrete activities that a firm performs in generating and delivering value to its customers. Activity category templates are used to analyze activities and develop means to reposition the firm. However, while Porter's initial formulation assumed that the value chain activity template (Figure 1) was applicable in all industries and all firms, value configuration theory proposes that the value chain is a good representation of one of three basic value creation technologies. The chain represents manufacturing of physical goods with its focus on the transformation and assembly of inputs into finished goods. The other two value configurations are for problem-solving services and mediation services. The relevant activity templates have been labeled the value shop and the value network.

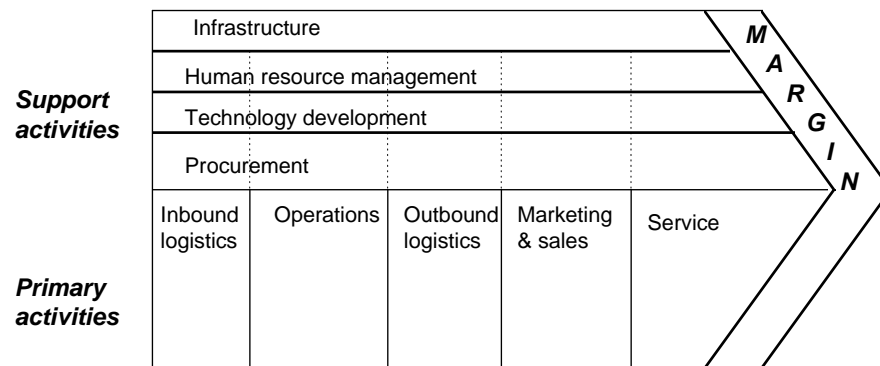


Figure 1. Value Chain Activity Template

The purpose of this chapter is to give an up-to-date summary of value configuration theory¹. The chapter uses examples from the petroleum industry to illustrate concepts and applications where appropriate. The emphasis, however, is on concepts and analytical frameworks. The next two chapters of the report, on the other hand, focus on application to the petroleum industry.

The chapter gives both an applied introduction to value configuration theory and reviews lessons learned from our research and application of the theory. In the process we also attempt to evaluate the potential of the theory and identify issues that need further research.

In our presentations and applications of value configuration theory we often experience that our audience is not very familiar with the literature on competitive advantage and the use of the value chain model. In some sense, the value chain has become so ubiquitous in the language of business and management that it has lost all its analytical meaning. We therefore feel it is useful to start with a brief recap of the basic ideas of competitive advantage and competitive strategy. In the process we link value configuration theory both to the analysis of competitive advantage at the level of the firm (the strategic business unit - SBU) and to the analysis of industry attractiveness and competitive strategy options.

The rest of this chapter is therefore organized as follows. First we present an overview of the basic idea of modern competitive strategy where the industry is the arena and activities are the basic analytical building block for the implementation of competitive strategies. We then present the key ideas of activity-focused value configuration analysis where primary activities define value delivered to buyers, where drivers are key to the choice of strategic positioning and where there are three basic value configurations. Value configuration analysis is then linked to the analysis of the structural determinants of both industry attractiveness and alternative competitive strategies. With these basic foundations we are prepared to review some of the key lessons of our research on both value configuration analysis and industry analysis. These lessons are organized around a discussion of the following issues:

- Existence of hybrid value configurations?
- Challenges in applying the alternative value configuration templates?

¹ For more details see also Fjeldstad and Stabell (1997) and Stabell and Fjeldstad (1998).

- Distinctive drivers of cost and differentiation?
- Key strategic positioning options?
- Link between industry analysis and value configuration analysis?
- What kind of theory is value configuration theory?

Competitive strategy and competitive advantage

The basic idea of modern competitive strategy is deceptively simple. Effective competitive strategy is the search for a position where the firm can achieve and sustain above average economic returns. The basic arena for understanding and achieving competitive advantage is the industry. The industry is the group of firms producing and selling goods or services that compete directly with each other.

Competitive advantage is achieved by being able to offer the same product at less cost while achieving above average returns. An alternative strategy is to achieve competitive advantage by establishing and maintaining an attractive and distinctive product offering, again while achieving and sustaining above average returns. Achieving a unique product offering, achieving differentiation, implies establishing and dominating an industry segment.

Both competitive cost leadership and competitive differentiation in product offerings is determined by what the firm does – what activities the firm chooses to do to produce the offerings, how the firm chooses to do these activities and how well the firm is able to coordinate the activities. Thus while the industry is the arena for competitive strategy, then activities are the critical levers of competitive advantage. Activities are the means to realize and implement a competitive strategy.

What a firm does and competitive strategies in an industry must obviously be interrelated. Thus activity configuration and competitive strategy are interrelated. The main difference is that activity configuration – scope of activities, coordination of activities, how activities are performed – focuses the firm while competitive strategy must consider the positioning of the firm relative to competitors and other industry actors. We start, however, here with a focus on activity configuration as the firm and its activities define in the final count firm-level economic returns.

Value configuration theory

Value configuration theory starts from the premise that the activities of the firm are the appropriate focus if we are to understand and manage from a strategic perspective both value created and costs incurred. The theory distinguishes between two main classes of activities in the firm (see Figure

1). Primary activities are directly involved in creating the value that is purchased by the buyer. Support activities, on the other hand, are activities that impact value purchased only through their impact on primary activities. Thus while manufacturing operations are a primary activity category in the automobile industry, then activities such as development of new models and production process innovations impact value indirectly, primarily through their impact on future manufacturing activities.

Value configuration analysis is designed to assess and understand the current and future competitive position of the firm. It also serves to determine how activities can and need to be reconfigured in order to attain a position of competitive advantage in line with the competitive strategy of the firm.

Value configuration analysis needs to be complete and systematic in order to identify clearly key activities that define value and costs. A template of activity categories is offered as a means to make a complete inventory of all value activities.

Inventorying and evaluation of activity costs and value contribution is merely a first step in value configuration analysis. Developing a sustainable competitive advantage requires attention to the drivers of activity cost behavior and the drivers of the final product differentiation created by activities.

Drivers can be defined as either structural attributes of activities or structural attributes of the relationship between activities (Sheehan, 2000). Using this definition, we see that drivers can be:

- structural properties of activities. Scale, location and capacity utilization are examples of this type of driver.
- structural properties of the process by which activities are put in place or evolve. Timing of the acquisition or implementation of an activity is an example of this type of driver.
- structural properties of the relationship between activities. Vertical and horizontal linkages across activities within the firm or between firms are examples of this type of driver. The linkages can be in the form of business related exchanges, coordination exchanges and expectation exchanges between activities. Reputation is an example of an expectation exchange.

Competitive strategy tries to locate the firm in a unique and sustainable position relative to cost and differentiation drivers. Positioning can also

involve reconfiguring activities (what activities are involved and how activities interact) and developing new technology platforms for activities.

Consider scale. To the extent that there are significant economies of scale in manufacturing, then a firm needs to choose horizontal scope of activities (in terms of markets served) so as to achieve the necessary scale.

Multiple drivers can affect the same activities. A driver can impact several activities. Consider scale and capacity utilization. While horizontal scope of activities might give a basis for scale in manufacturing, the firm needs to choose vertical scope of activities in order to secure that manufacturing can operate with high capacity utilization. Robust positioning therefore most often involves a set of drivers and a set of activities.

Drivers are structural in the sense that they are relative and relational properties of activities. They therefore are relatively abstract and can be evaluated and interpreted through comparison across firms and industries. Identifying and applying conceptual drivers involves establishing meaningful operationalization in the specific industry and firm considered. For example, scale in manufacturing is defined differently from scale in services.

Value configuration theory proposes not only that operationalization of drivers differs across firms and industries, but that these differences follow a systematic pattern. The pattern defines the set, role and interdependence of critical drivers and thus strategic positioning options. The fundamental determinant of patterns in drivers are differences in value creation technology. Following Thompson (1967), the theory proposes that there are three and only three basic value creation technologies: a long-linked technology used in the manufacturing of goods, an intensive technology used in problem-solving services and a mediating technology used in mediation service industries.

The theory has developed distinct activity templates for the analysis of activities across value creation technologies. The value chain (Figure 1) is relevant to the analysis of manufacturing firms using a long linked technology, while the value shop (Figure 2) is a template for problem solving services and the value network (Figure 3) is an activity template for firms delivering mediation services.

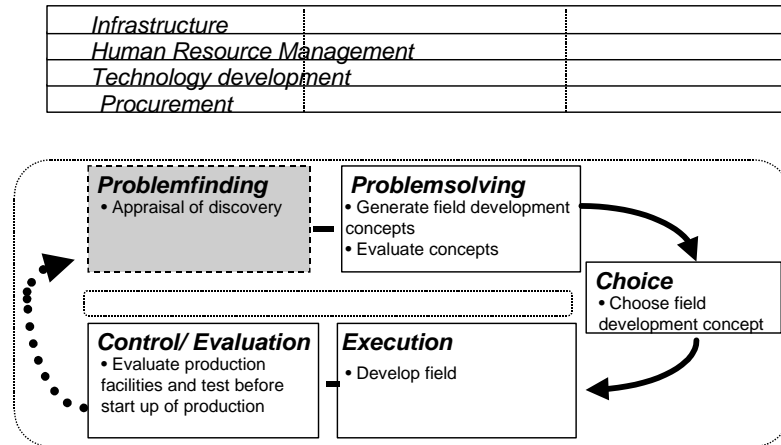


Figure 2. Value Shop Activity Template (applied to a field development contractor)

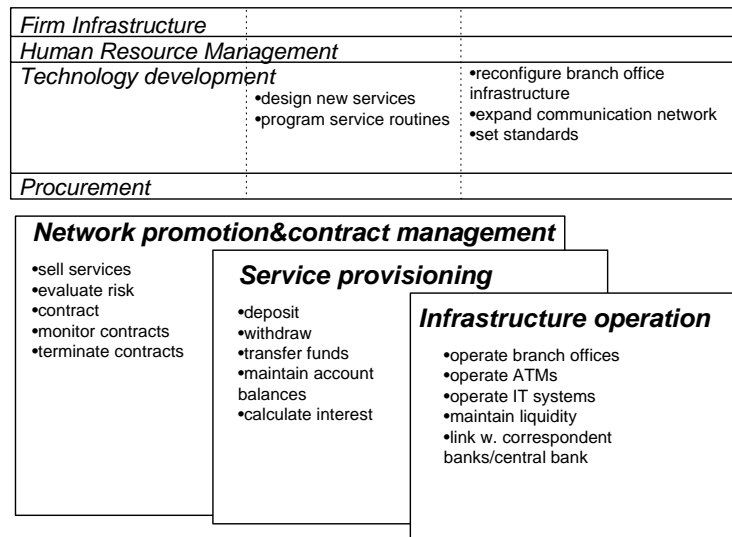


Figure 3. Value Network Activity Template (applied to retail banking)

The value configuration templates differ in terms of primary activity categories. Support activity categories are the same although their relative importance and implementation can differ across the three value configurations.

The activity templates are designed to capture and signal the main differences in value creation logic and in the relationship between activities. Using the templates therefore becomes a shorthand value configuration notation. The templates, however, are used to identify and structure the analysis of all value activities. And most important is to use the understanding of the logic of the value configuration as a heuristic to search for and define effective strategic positioning options.

Table 1 (selected and updated version of a similar table in Stabell & Fjeldstad, 1998) summarizes the main differences across the three value configurations (referenced with the label of their respective value configuration templates). The table captures that the differences in value creation technology is the main underlying condition and develops a pattern in not only activity categories and logic, but also in drivers and structure of the primary business value system.

Table 1. Key differential properties of value configurations

	Chain	Shop	Network
Value creation logic	Transformation of inputs into goods	(Re)solving customer problems	Linking customers
Primary technology	long-linked	intensive	mediating
Primary activity categories	<ul style="list-style-type: none"> • Inbound logistics • Operations • Outbound logistics • Marketing • Service 	<ul style="list-style-type: none"> • Problem finding/acquisition • Problem-solving • Choice • Execution • Control/evaluation 	<ul style="list-style-type: none"> • Network promotion/contracting • Service provisioning • Infrastructure operation
Primary interactivity logic	sequential	interactive	synchron
Key cost drivers ²	<ul style="list-style-type: none"> • Scale • Capacity utilization 		<ul style="list-style-type: none"> • Scale • Capacity utilization
Key value drivers		<ul style="list-style-type: none"> • Reputation 	<ul style="list-style-type: none"> • Scale • Capacity utilization
Primary value system relationships	Interlinked chains	Referred shops	Layered and interconnected networks
Primary value system structure	Dyads	one-to-many	many-to-many

² We see that Porter is right that scale and capacity utilization is a dominant driver for the largest industries in the modern economy. But he misses that it can be both a value and a cost driver.

Our research has mainly confirmed, elaborated on and reinforced the main tenets of value configuration theory. The research has also raised issues concerning both the theory and its application. In what follows we develop some of the lessons learned that would seem to apply broadly across a range of industries. Subsequent chapters look more closely at applications to the petroleum industry.

Discussion

Hybrid value configurations

In our initial formulation (Stabell and Fjeldstad, 1998), we suggested the possibility of hybrid configurations. A hybrid is a firm that contains more than one type of value configuration. We also suggested that the same type of firm (e.g., higher education institution) can be looked at as an example of all the different value configurations. And finally, we suggested that a support activity group (such as those involved in technology development) can be a different type of value configuration than the configuration of the primary activities.

We now would emphasize that the concept of a value configuration applies at the level of the strategic business unit (SBU). A firm can have several SBU's and as such contain more than one value configuration. But the SBU has most often a single value configuration.

The revenue basis is the critical test for determining the appropriate value configuration model for a SBU. Thus even though a manufacturing firm has a unit that does trouble shooting in terms of keeping manufacturing operations up and running, the value configuration is a chain as long as customers pay for the goods produced.

Thus value configuration and business model are intimately linked. The business model is defined by the primary activities of the SBU as primary activities are where value is actually delivered to buyers.

It is, of course, possible for firms to migrate business models. Consider the case of Elkem. The company started as an engineering company and developed a patent for a smelter. It sold licenses to its patent and services around applying the licenses. Clearly, here Elkem was a firm that sold a problem solving service where it had a patent on its solution. Elkem later moved into getting revenue from the sale of the goods produced using its solution. It then became a manufacturing company. At a certain time therefore it both sold services from and used its own development department. Development was both an SBU and a support activity for

another SBU. Currently the firm appears to have largely discontinued its problem solving services for sale. It has become a pure manufacturing play.

The Elkem case illustrates the key role of the revenue model and buyers of value produced for the definition of a firm's value configuration. During the period where it both sold and used engineering services as a support activity, Elkem can be interpreted as having two distinct SBU's and two value configurations. However, they had strong linkages as they shared activities.

Choosing value configuration and business model obviously can mean moving between segments in an industry (or from one industry to another). Choosing type of configuration is a generic dimension of strategy beyond (or prior to) choosing between a cost leadership and a differentiation strategy. And firms can get stuck in the middle between several value configurations, just as they can get stuck in the middle if they are not successful when trying to pursue simultaneously cost leadership and differentiation (Porter, 1980).

An industry can have firms with different value configurations. However, we would now emphasize that the firms with the same value configuration define groups within the industry.

Applying the value configuration templates

The activity templates and value configuration models appear to give a lot in terms of understanding businesses. Using the activity templates focuses attention and forces a clarification of the nature of the business model. However, we have also experienced problems in applying the models not only in our own research efforts, but also when practitioners and students attempt to apply the models.

The problems are in terms of classification of businesses (i.e., determining the appropriate value configuration model), in terms of categorization of activities according to the appropriate activity template and in terms of estimating the cost or value contribution of activities.

Note that activity categorization and evaluation problems should be compared to the earlier problems encountered in applying the value chain template to all firms (Stabell and Fjeldstad, 1998). And effective analysis for competitive advantage is almost by definition challenging. If it were not so, then all firms would rapidly be able to attain the same position and there would be little potential for sustainable competitive advantage.

In terms of business classification, one might argue that all businesses sell a solution to a buyer problem. How can one define problem solving as the distinctive attribute of value shops?

This argument misses a couple of key points. First, not all businesses are actively involved – often for a fee – in assisting their clients in defining that they have a problem and in evaluating that the problem has been solved. Second, many businesses are not actively involved in producing the product while it is being consumed – one of the key identifiers of services in general.

Distinguishing mediation services from problem-solving services can be more challenging. Both are services, and clearly mediators are solving problems for their clients.

Consider the case of the travel agent that assists customers in finding transportation. Such a service would most often be considered a mediation service. But it could also be seen as a problem solving service (ref Afuah and Tucci, 2000).

Resolution of the issue requires looking at the business model. If the travel agent is paid on an hourly basis or for advice concerning transportation alternatives, independently from the purchase of a transportation service, then the service is a problem-solving service. However, if the agent is primarily paid for the service as part of the payment for the actual transportation service (the ticket), then the travel agent is a mediator (broker) linking buyers and sellers of transportation services.

The problem of activity categorization is obviously related to the issue of business classification. But it is also an issue of our choice of activity categories for each configuration. We have found it difficult to separate out and evaluate *problem finding* and *problem solving* activities in shops. Similarly, it has often been difficult to separate *service provisioning* and *infrastructure operation* in mediators.

Part of the issue in shops reflects the recursive nature of problem solving where implementing a solution defines new problems and where solving one problem can generate a new problem. Again, we need to see what the client is buying. Depending on the client's relationship with the shop, higher order problems might either involve support activities, a distinct business or an integrated solution in a single business.

The problem of separating service provisioning from infrastructure operation and the problem of separating different “wheels” of a problem solving cycle

has practical implications. The distinctions imply alternative boundaries of the shop or mediator. This boundary definition captures the potential for alternative configurations. It also serves to assess both costs and differentiation contribution. Shops refer clients (problems) to other shops just as mediators mediate over other mediators in addition to being interconnected with other mediators.

A closer look at the relative role and extent of different activity categories together with the revenue model gives the basis for defining sub-classes of configurations. In shops, we have proposed that there are three basic types: search shops, design shops and diagnosis shops (Stabell, Fjeldstad and Sheehan, 1999).

Cost and differentiation drivers

Activity templates give a first order basis for assessing and managing competitive advantage. However, significant and sustainable advantage requires that the firm exploit the potential of drivers. Drivers are the critical competitive advantage element in value configuration theory.

Porter's (1985) initial formulation of the concept of drivers was rather brief. It considered what drivers do, not what they are. Porter emphasized presenting a comprehensive list of different drivers. His discussion was largely focused on the issue of operationalization. He distinguished between cost and differentiation drivers, but the distinction was largely in terms of relative importance as all but one cost driver (capacity utilization) is also a differentiation driver.

Without a more formal definition of the concept, it is difficult to determine if Porter's list of drivers is complete, consistent and non-repetitive. We propose a simple definition where drivers are structural properties of activities and structural properties of the relationship between activities (Sheehan, 2000). Using the formal definition, we conclude that Porter's list is relatively complete. It is more an issue of whether some of his drivers fit the definition.

According to Porter, there is an inverse relationship between cost and differentiation drivers in terms of importance. The most potent and significant cost drivers tend to be less important differentiation drivers. And vice versa. Value configuration theory argues that this depends on the value configuration. Thus while scale is mainly a cost driver in chains, it is both a cost and a differentiation driver in networks. Similarly, capacity utilization is an important cost driver in chains while it is both a cost driver and a value

driver in networks, but here the relationship is negative: high capacity utilization reduces costs, but also reduces value delivered to buyers.

We argue that in shops, the critical drivers are drivers of value. And that the strategically most important differentiation driver is reputation. Our study of the reputation in exploration suggests clearly that it is an important differentiator as reputation is unevenly distributed (Sheehan, 2000).

Our work on drivers underlines the importance of linking drivers to activities and not to the firm as a whole. Multiple drivers can impact a single activity. And the same driver can affect several activities.

To the extent that critical drivers affect all activities, it obviously is less important to disaggregate the firm into its constituent activities. However, detailed activity analysis is required before one can be sure that all value activities are similarly affected by the same critical drivers.

Strategic positioning options

Drivers are important for choosing strategic positions. Alternative positions are defined in terms of the scope of the firm and the mechanisms chosen to coordinate activities. Value configuration theory also suggests that choice of configuration is a major positioning choice, although one might argue that changing type of configuration is in reality a choice of what industry (segment) to be positioned in.

The choices of scope and coordination are perhaps clearest in chains and networks, but they also apply in shops. For both chains and networks there is a choice of both vertical and horizontal scope. Vertical scope is how much of the value system is covered from suppliers through intermediate buyers. Horizontal scope is coverage in terms of market segments and offerings. In mediation horizontal scope defines how large set of customers the mediator services directly. Through interconnect agreements, the virtual customer set (network) can be universal. Vertical scope in mediation defines how many mediation layers the firm covers. Coordination can be arms length or it can be through more or less long-term agreements.

A basic proposition for chains is that they tend to increase vertical scope in order to assure scale and reduce fluctuations in operations (Thompson, 1967). Networks tend to increase horizontal scope in order to both deliver and capture value in a mediation service.

Vertical scope in shops can be defined in terms of the number of wheels in the recursive problem solving cycle that the firm covers. Horizontal scope

defines how much of a potentially interrelated problem space the shop covers.

Our research suggests that we had neglected the role of intense interaction with clients (problems) as a property of shops (cf. Thompson's reference to their technology as an intensive technology (see Afuah and Tucci, 2000)). Effective interaction and interaction on the premises of the client is an element of strategic positioning of a shop. The resulting internalization of the problem serves not only to secure effective mobilization of resources, but also can promote more effective interaction between the shop and the client (problem). Broad horizontal scope can improve problem acquisition in shops.

Alternative coordination mechanisms between firms are strategic positioning options. A tapered strategy, where the firm focuses on a limited set of activities in the value system, but is active in a larger set, is one of the mechanisms. A tapered strategy can give the benefits of focus while maintaining coordination almost equivalent to that obtained with full vertical integration.

Value configuration analysis and industry analysis

As noted earlier, while the industry is the arena for competitive strategy, then activities are the critical levers of competitive advantage. Activities are the means to realize and implement a competitive strategy. In other words, value configuration analysis and industry analysis need to be linked.

Porter developed the link as he developed his theories, starting with the industry and the 5-forces model for doing industry analysis (Porter, 1980). He then followed up with implementation of competitive strategy for competitive advantage with a firm-level analysis using the value chain framework (1985)³.

As formulated by Porter, industry analysis frames value chain analysis, both conceptually and procedurally. Of course, the analysis has to start at the level of the firm in the sense that a firm is key to defining the industry in terms of its boundaries within the larger value system.

Industry analysis, however, changes with the perspective of value configuration theory. Or stated differently, industry analysis in value configuration theory needs to consider that the structure of the arena for

³ And he has subsequently moved up to the competitiveness of industries across geography and nations (Porter, 1990).

competitive strategy changes when we recognize alternative basic value configurations.

Briefly stated, dyadic buyer-seller relationships in a manufacturing industry are replaced by many-to-many relationships in mediation and problem-solving industries. Competitors collaborate in providing services. Rivalry is replaced by coo-petition. Bargaining power depends on the topology of relationships and the pattern in trading of mediations or referrals.

Consider the case of a mediation industry where actors are interconnected. The bargaining position of an actor can be illustrated with a simple mediation trade matrix.

Consider an industry with two mediators A and B (Figure 4). The entries in each cell show the relative amount of mediation within and between mediators. Thus according to the matrix, 50% of the total mediation transactions are between customers of A, while 25% of the transactions are from customers in B's customer set to customers that belong to A's customer set.

		To	
		A	B
From	A	50%	5%
	B	25%	20%

Figure 4. Mediation Industry Trade Matrix

In this simple example, we see that A is the dominant actor. A has a strong bargaining position because (a) it is relatively larger than B and (b) because there is much more mediation from B to A than from A to B. Figure 5 implies a much more balanced bargaining position even though actor A is even larger in terms of relative mediation volume.

		To	
		A	B
From	A	70%	5%
	B	5%	20%

Figure 5. Balanced Mediation Trade Matrix

The implication is that we need to start with a clear understanding of not only the industry boundary, but also of what kind of industry we are dealing with. This requires an initial formulation of the firm's value configuration. Subsequent analysis of industry forces needs to vary with whether we are

dealing with a manufacturing, a mediation or a problem-solving industry. Having defined alternative competitive strategies, we now move into a more detailed analysis of the focal firm's value configuration, of critical drivers and of positioning alternatives. And positioning requires attention to industry dynamics: changes in industry structure and competitive responses. In short, analysis of competitive strategies and competitive advantage is not a simple top down or bottom up process. With value configuration theory, it is clear that the process must be iterative and interactive, moving both up and down in terms of level and scope of analysis.

What kind of theory is value configuration theory?

We have labeled our work as an effort directed at developing, researching and applying value configuration theory. In what sense is it a theory?

Porter proposes the value chain as a framework for the analysis and management of competitive advantage (1985). His emphasis is on identifying key variables and offering a robust foundation for doing analysis of competitive advantage (Porter, 1991). His emphasis is also very much on providing a generic framework that is applicable to all industries and firms.

Value configuration theory extends the repertoire of value configurations with distinct patterns in terms of both the logic of value creation, the nature of relationship between firms in the larger value system, and the nature and role of critical drivers. As such concepts and variables are conditioned and related. This would appear to satisfy the usual requirements for a theory.

Value configuration theory has a strong prescriptive orientation, primarily in terms of how the concepts and propositions should be used to do analyses of and for competitive advantage. However, the theory has also a descriptive element. Concepts concerning what drivers are important in what contexts should also have descriptive validity. Prescriptions in terms of positioning options should also be empirically observable in the sense that firms with superior performance should adhere to these precepts.

Value configuration theory has much in common with theories of the firm. Theories of the firm are attempting to frame and understand similar issues as those addressed by value configuration theory: boundaries of the firm, effective governance structures. The main exception is that value configuration theory is not trying to address the issue of why firms exist. However, as suggested by our analysis of the application of value configuration theory to the petroleum industry (see next chapter), it is precisely the development and evolution of both market and non-market interactions between firms that set the stage for a rich "flora" of alternative

value configurations in an industry. One might argue that value configuration theory provides an important element that has been missing up to now in theories of the firm: a theoretical foundation for the role of the technology of the firm.

Concluding comments

This chapter has presented a summary of the main elements of what we currently understand as value configuration theory. The initial focus of the theory was firm-level competitive advantage, both in terms of understanding and prescribing how to define and attain a position of sustainable competitive advantage. We have subsequently increasingly also emphasized the implications for industry level analyses of competitive strategy.

Our own work and that of other efforts to apply value configuration theory demonstrate the potential of the theory. In terms of both applying and further developing the theory with related models, we have suggested the following:

- Value configuration is a business unit concept. Although the concept of alternative value configurations is intuitively applicable to describing differences in terms of classes of activities in firms, the focus for application of value configuration theory is the business model of the firm and thus the strategic business unit in corporations.
- Application of value configuration theory as a basis for the analysis and management of competitive advantage is not straightforward. Identification of relevant benchmark activity templates with parameterized estimates of structure is one important basis for promoting and assisting application. Our work on petroleum exploration shops reported in subsequent chapters is an example of the kind of empirical foundation required.
- There are many areas in need of further development in value configuration theory. The work reported in this chapter points to the need for theoretical efforts directed both at the corporate strategy implications of value configuration theory and at industry level implications and concepts.

3. Competitive Strategy in the Petroleum Industry

The petroleum industry has recently seen mega-mergers where some of the largest firms in the global economy have joined forces to become even bigger. What are the forces that lead to this behavior? What do these events tell us about the attractiveness of the petroleum industry, about competitive strategies and about how the industry might evolve?

Consider Chevron's recent acquisition of Texaco. In the immediate aftermath, several arguments and interpretations have been advanced (NYT, Oct 10 2000).

One argument for the Texaco-acquisition is size and competitive response: "The last two years have produced industry mammoths such as ExxonMobil and BP Amoco, now known as BP. Smaller companies like Chevron and Texaco face the risk of losing out on oil projects and investor interest if they stay small." Note that both Chevron and Texaco are large companies by any standard.

Another line of argument refers to the potential of complementary (read cheap) assets: "Texaco has good assets and Chevron has the management to turn them around". A variant of the same argument is access to particularly attractive and synergistic assets: "The merger would give the combined company the greatest number of leases to oil reservoirs far below the waters of the Gulf of Mexico. Chevron Texaco would also become an even more powerful presence in the deep-water offshore areas of Brazil and West Africa".

Simplifying a great deal, these interpretations suggest two basic arguments: a cost argument and a relationship argument. These are potentially interrelated arguments in that good relationships (with owners of prospective acreage) gives access to the best acreage, where best is synonymous with acreage with the lowest unit costs⁴. The arguments are, however, slightly different in that they imply access to proven petroleum resources as opposed to access to acreage with potential.

A basic tenet of modern competitive strategy literature (see Porter, 1980, 1990) is that we need to look at the larger *value system* of activities and actors in order to evaluate the potential of an industry and understand effective competitive strategies. Suppliers and buyers, and not only direct

⁴ Only here focusing upstream arguments. Obviously also relevant to consider downstream.

competitors, affect both how much value is created and who gets what share of the value created by the value system.

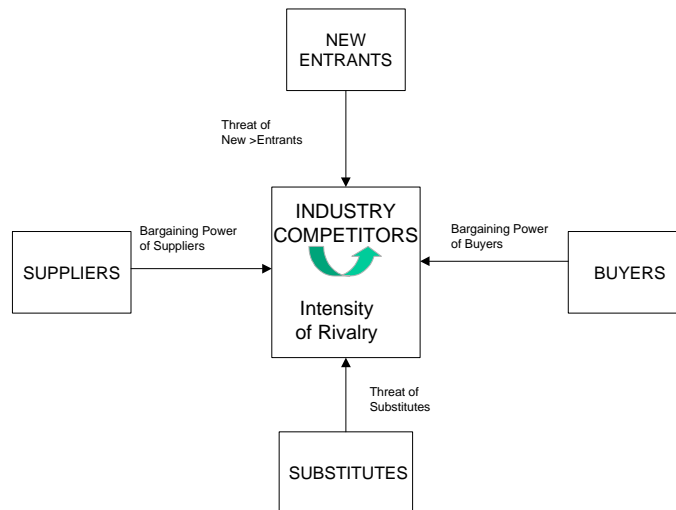


Figure 6. 5-forces framework for analysis of an industry (Porter, 1980)

Figure 6 shows the elements of Porter's (1980) 5-forces framework for the analysis of industry structure. Threat of new entrants, threat of substitutes, bargaining power of buyers, bargaining power of suppliers and intensity of rivalry between competitors are the 5 forces. These forces are shaped by structural attributes of the industry such as economies of scale, concentration and mobility barriers.

Consider the PC industry. It is now very competitive, with small margins. Intel, however, has been able to obtain extremely good returns. The 5-forces framework explains this as due to Intel's near monopoly position as supplier of micro-processor chips.

Application of the 5-forces framework involves defining the focal industry, delineating the relevant value system and thus the main existing (and potential) actors in the industry. You then evaluate the structural forces that shape value created and who appropriates what share of this value. Understanding the industry in terms of competitive forces not only gives a picture of the attractiveness of the industry. It is also used to identify

effective competitive strategies. Porter (1980) argues that there are only two basic, alternative competitive strategies: cost leadership and differentiation⁵.

We report here on research that started from the idea that much of modern competitive strategy literature was primarily relevant to industries that were dominated by a manufacturing logic (see Stabell and Fjeldstad, 1998; see also Afuah and Tucci, 2000). Our initial focus was on the firm-level analysis of competitive advantage. We suggested that Porter's value chain framework (1985) was relevant to manufacturing firms, but much less so to firms that sell problem solving services (think consulting and engineering services) and that sell mediation services (think financial, transportation and communication services). However, our work has also suggested that the different business logics of problem solving services and mediation services implies differences in terms of industry structure and in terms of what are effective competitive strategies. And the petroleum industry is increasingly an industry where all the 3 different business logics interact and define the competitive arena.

In what follows we first outline the new competitive strategy theory of alternative value creation logics, or what can be labeled Value Configuration theory. We then apply the distinction between the 3 business logics to the petroleum industry. Particularly when we focus on different segments of the industry, we see clearly the role of the different value configurations and how they both interact and co-exist. We then apply the models to two alternative perspectives on the upstream petroleum industry. In one, it is an industry of firms that explore and produce petroleum, getting their revenues from the sale of petroleum. In the other perspective, upstream petroleum is increasingly an industry of firms that sell a problem solving service directed at finding and producing petroleum for owners of prospective assets.

Our analysis of competitive strategy in the upstream petroleum industry is primarily to illustrate the applications of Value Configuration theory. It has much broader application as shown by our brief reviews of a range of issues such as the attractiveness of the Heavy Oil industry in Canada and impacts of changes in the regulation of gas transportation in Europe (see references).

⁵ Porter argues that trying to pursue both a cost leadership strategy and a differentiation strategy leads to getting "stuck in the middle" with poor long term prospects. Raises the issue of whether the mega-mergers will result in firms that are stuck in the middle, or is the petroleum industry an arena where Porter's ideas are refuted?

Value Configuration Theory

Value configuration theory focuses firm-level competitive advantage. It starts from the premise that competitive advantage cannot be understood by looking at the firm as a whole. Competitive advantage stems from the many discrete activities a firm performs in generating and delivering value (Porter, 1985). Each of these activities can contribute to a firm's relative cost position and create a basis for differentiation. There is a fundamental distinction between primary and support activities. Primary activities deliver value to the customer. They define the firm's business model. Support activities (such as R&D, HRM, purchasing) support primary activities and impact customer value solely through their impact on current (and future) primary activities.

According to value configuration theory there are three basic, alternative ways that firms create value. In addition to Porter's initial formulation with the value chain (Figure 1), value configuration theory proposes that there is the value shop and the value network (see Figures 2 and 3). While the value chain is a template for the analysis of firms that deliver value by transforming inputs into goods, the value shop is a template for the firms that deliver value by solving a customer's problem. The value network is a template for firms that deliver value by mediating between customers.

Value configuration theory provides a systematic basis for analyzing and developing competitive advantage in all types of firms. A firm is broken down into value activities where costs and value generated are allocated and estimated, either using the value chain template for manufacturing firms, value network template for mediators, or value shop template for problem solving service firms. The results of this activity-directed review are used to identify the competitive strengths and weaknesses of the firm.

A second order and more fundamental analysis focuses the drivers of activity cost behavior and value delivered by activities. Drivers are structural properties of activities such as scale, location, learning and timing. Drivers are also structural properties of relationships between activities in the firm and activities in other firms in the value system. An example of a structural property of the relationship between activities is how input quality assurance impacts activity rejection costs in manufacturing. Another example is how documentation activities in prospect evaluation affects value delivered by post-drilling evaluation activities.

We distinguish between cost drivers and differentiation drivers (Porter, 1985). Differentiation drivers affect the unique value delivered by the activity and thus the premium price that the customer is willing to pay. The

logic of the value chain implies a focus on cost drivers, while a value shop business is more concerned about differentiation.

Table 2. (from Stabell and Fjeldstad, 1998) summarizes key attributes of the 3 value configurations

Table 2. Differences across value configuration logics in petroleum industry

	Chain	Shop	Network
Value creation logic	Transformation of inputs into goods	(Re) solving customer problems	Linking customers
Petroleum industry example	Petroleum production, oil refining	Drilling services, engineering services, consulting	Gas and oil transportation, oil and gas exchanges, brokering
Primary technology	long-linked	intensive	Mediating
Key cost drivers ⁶	<ul style="list-style-type: none"> • Scale • Capacity utilization 		<ul style="list-style-type: none"> • Scale • Capacity utilization
Key value drivers		<ul style="list-style-type: none"> • Reputation 	<ul style="list-style-type: none"> • Scale • Capacity utilization
Primary value system relationships	Interlinked chains	Referred shops	Layered and interconnected networks

The repertoire of three alternative value configurations is important in order to both understand and analyze business logics across firms and industries. However, we argue that industry structure and forces are also different when we move from manufacturing to mediation and problem solving industries. Industry structure mirrors the logic of value creation. Differences in value creation logic are also reflected in differences in industry structure and dynamics.

Simply stated, industry structure reflects the structure of relationship between actors. The basic structure of relationships in a manufacturing industry is the dyadic buyer-seller relationship. The relationship replicates between the firm and its suppliers as well as between the firm and its buyers. In both mediation and problem solving industries, on the other hand, there is a many-to-many relationship between actors. Buyers are serviced

⁶ We see that Porter is right that scale and capacity utilization is a dominant driver for the largest industries in the modern economy. But he misses that it can be both a value and a cost driver. Note also that reputation/success is similar to scale in that effective scale also implies success?

concurrently (or virtually) by more than one supplier. Actors interchange buyer and supplier roles in the course of their interactions and exchanges.

Consider gas mediation. A gas pipeline company mediates gas between suppliers and users of gas. The pipeline company might, however, also connect with a potential competitor in order to mediate gas between one the pipeline company's suppliers and the competitor's customer /user of gas. Similarly, the pipeline company might assist their competitor in mediating gas to one of its own customers. In terms of the structure of the mediation industry, rivals not only compete but also need to bargain in terms of their interconnected buyer-supplier relationships. And the structure of mediations across customer sets relative to mediations within customer sets is an important determinant of relative bargaining power.

This dual competitive and cooperative interaction among rivals is even more prevalent in problem-solving industries. Rivals compete for problems, but also refer, subcontract and jointly solve problems. Reputation and rankings structure competition in a setting (i.e., industry) where winners often appear to take all (or at least the best problems and opportunities).

Before we develop this last point in more detail, let us take a closer look at the different kinds of value creation logics in the petroleum industry.

Value Creation in the Petroleum Industry

In order to apply Value Configuration Theory to the analysis of the petroleum industry we need to define the key activities and actors. Figure 7 shows the value system for the industry that serves end-users of petroleum products. The value system model only considers the actors directly involved in the discovery, development, production and distribution of petroleum products. This is what we label the primary petroleum value system.

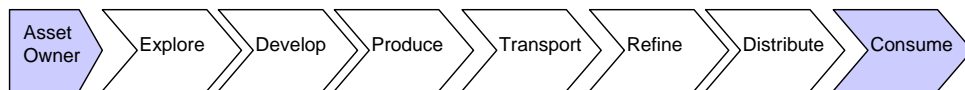


Figure 7. The Primary Petroleum Value System

Historically firms (the Majors) that were vertically integrated over the whole petroleum value system dominated the petroleum industry. The integrated petroleum firm has a manufacturing (chain) logic.

With the creation of spot markets and the deregulation of the different intermediate activities, most importantly the market for crude oil, the integrated petroleum industry has been de-coupled along the different stages

in the value system. With this de-coupling we see the emergence of actors with quite different business logics. At the level of the combined upstream and downstream petroleum industry, we see primarily two main classes of actors: manufacturers and mediators (see Figure 8)⁷.

	Acquire Assets	Explore	Develop & Produce	Transport	Refine	Distribute	Retail	
Independent (Apache)								CHAIN
Shipper (OMM)								NET
Refiner (Lyondell)								CHAIN
Pipeline (Union Pacific)								NET
Retailer (Quick Trip)								CHAIN /NET
Integrated Major (Shell)								CHAIN

Figure 8. Prototypical actors in the primary petroleum value system

De-coupling together with competitive pressures has led even the majors to outsource activities. For example, majors used to transport oil using their own tankers. This activity is now outsourced. However, a percentage of the crude is still transported on tankers owned by the majors. This tapered vertical integration maintains a credible bargaining position in addition to provide knowledge and information on the activity.

Gas pipeline transportation has been outsourced through regulatory initiatives. Requirements for third party access has led to the establishment of pure gas mediators. Our analysis (Fjeldstad, Stabell and Kolbjørnsrud, 1998) suggests that this liberalization will lead to not only cheaper gas to end-users, but also to an increase in supply from smaller fields. Competitive pressures and drivers of value and cost, however, seem to push vertical integration of pure gas mediators upstream into gas resources or downstream into retailing.

⁷ It is interesting to note that historically, the industry giants succeeded by controlling the mediation activity: Standard Oil through its control of pipelines and Shell through its innovation in tankers for shipment of petroleum products. Their move upstream into exploration and production was designed to secure supplies and effective operation of refineries.

Problem solvers in upstream petroleum

We do not see any problem-solvers (value shops) in our map of the petroleum industry value system. They are, of course, present all over as suppliers of problem solving services such as consulting services and engineering services. But these firms do not figure in the core petroleum industry value system in the sense that they are directly involved with the transformation of petroleum in the ground to the final consumption of petroleum products.

To see the whole range of alternative value configurations, we focus a more limited segment of the petroleum value system. Figure 9 illustrates the upstream segment of the petroleum industry. The focal firm is the petroleum exploration and production (E&P) company. The buyer is a spot market for crude and the suppliers include the suppliers of both equipment and services.

Suppliers	Industry Competitors	Buyers
<ul style="list-style-type: none"> • Owners of prospective assets • Exploration goods and services • Field development goods and services • Field operation goods and services 	Petroleum E&P companies	<ul style="list-style-type: none"> • Spot market for crude and gas • Transporters • Refiners

Figure 9. Upstream Petroleum as a Manufacturing Industry

Table 3 presents an overview of the different categories of suppliers in upstream petroleum. One category that is missing is the owners of prospective assets. They are here not viewed as creators of value, but rather as owners of value.

Table 3. Value creation logic of suppliers in upstream petroleum

Actor	Examples	Role	Value Creation logic
Seismic services	PGS, GecoPrakla, TGS-NOPEC	Supplier of services that produce seismic data for both exploration and exploitation decisions	Shop
Drilling services	Transocean, Parker	Supplier of drilling of exploration and exploitation wells	Shop
Production equipment manufacturer	ABB, Coflexip Stena, FMC	Supplier of petroleum production equipment	Chain
Engineering service	Aker Maritime, Kværner	Supplier of field development solutions	Shop
Vendor of IT systems	ROXAR, Paradigm Geophysical	Supplier of interpretation and geoscience systems	Chain
Broker	IndigoPool, DiscoveryPlace	Broker of asset and data exchanges	Network

One might argue that many equipment vendors (chains) also sell problem-solving services. Should they therefore also be categorized as shops?

Value configurations are defined for strategic business units (SBU). In other words, value configurations are linked to distinct businesses, although these businesses might all reside in the same corporation. The critical issue is to what extent the problem solving service sold by equipment manufacturers is a distinct business unit or is it primarily a means to sell their equipment? In the latter case, the primary value configuration remains the chain. In the former case, the corporation might cover two value configurations, although not necessarily defined as two distinct business units.

Brokers of asset and data swaps and sales are the only mediators defined in the segment of upstream petroleum that is focused here. It is instructive to see that our examples of mediators are relatively new Internet-based service providers. We could also have included providers of transportation and telecommunication services as relevant mediators.

An even more focused look at upstream E&P identifies value shops in the core petroleum assets and equity petroleum focused part of the petroleum value system. If we consider solely petroleum exploration, we see at least three alternative exploration shops (i.e., where petroleum exploration is a strategic business unit distinct from petroleum exploitation):

- PROSPECT GENERATOR: identifies interesting prospects and presents them to potential investors that both acquire the prospective assets and finance exploration. Is paid through some form of carried interest or outright sale of ideas.
- ASSET PLAYER: identifies and invests in prospective acreage. Is paid through some form of carried interest.
- PROSPECT EVALUATION SERVICE: sells service to assist asset owner or prospect generator in evaluation of prospects. Is paid for service.

Figure 10 summarizes the differences between the 3 business models in terms of both scope of activities and revenue model. The asset player takes a greater risk than the prospect generator, but has also a higher percentage of the upside. Asset players differ to the extent that they are active and make further investments later in the exploration cycle. The prospect evaluation service shop takes no risk, but is also only paid for a service.

The distinctive aspect here is to what extent the petroleum exploration shop owns acreage. It is only by owning acreage that the shop can appropriate a significant share of the value of their efforts to find petroleum.

	Scouting	Acquisition of acreage	Seismic	Exploration drilling	Appraisal drilling	Revenue model
Prospect generator						Carried or bonus
Asset player						Carried
Asset player						Carried
Evaluation service						Fee

Figure 10. Alternative exploration shops

Actors involved in selling services and equipment in upstream petroleum can also become involved in the risks and returns of equity oil. For example, a field development solution provider might take some of its revenue in a share of equity oil. This can promote convergence between the interests of the asset owner and the field development solution provider⁸. It can also be a means for the oil equity owner to finance exploration and development

⁸ Note as there comes a market for assets, then more reasons to separate service providers and those that own equity oil.

activities. Taking such a position, however, requires that the solution provider also cover the necessary subsurface expertise. And the tight relationship between equity owner and supplier might limit the supplier's access to other petroleum E& P customers.

It is also possible to consider an extension of the exploration shop concept where the service provider also solves the problem of exploiting a discovery. We are then at the stage where the service provider overlaps the whole upstream activity set. Revenue might be in equity oil or it can be in a risk service contract. This is an alternative perspective on the role of the upstream petroleum exploration and production company, where it is contracted on behalf of the asset owners (typically national government or national oil company).

Alternative perspectives on upstream petroleum

This brings us to an illustrative application of the alternative value configurations at the industry level. Building on the work of Stenseth and Powell (1998), we contrast a view of the upstream oil & gas as a problem solving industry with a view of it as an industry that manufactures petroleum. In the former case, the industry is solving the problem of finding, developing and producing petroleum for clients (nations) that own prospective petroleum assets. In the latter (and traditional perspective), upstream petroleum is an industry where the focal firms are in the business of producing and selling petroleum. Acquisition of prospective assets, exploration for petroleum and development of discoveries are support activities.

Upstream Petroleum as a Manufacturing Industry

The key distinctive aspect of upstream petroleum as a petroleum manufacturing industry is that the revenue model is petroleum sales. Following our overview of the petroleum value system (Figure 7), this implies that the focal firm is the producer of petroleum. Acquisition, exploration and development of petroleum assets is required as petroleum reserves are depleted.

The market for petroleum defines the downstream limits of the industry (see Figure 9). In our analysis we will assume that the market is efficient. We will also assume an efficient market in petroleum assets. This would appear to be valid for many onshore assets in the US and Canada.

Assumptions of efficient markets for both petroleum assets (i.e. potential or identified petroleum in the ground) and petroleum at the well head limit the basis for competitive advantage. We identify three bases: differential

expectations, control of complementary facilities and activities that can prove to be bottlenecks with rapid shifts in the demand for their services, and new technologies (see Fjeldstad, Stabell, Sheehan and Powell, 1998).

Differential expectations can be concerning both asset prospectivity and future petroleum prices. Complementary activities involve first and foremost drilling, transportation and refining. New technologies can be both in petroleum exploration and in petroleum exploitation. In our study of the Canadian Heavy Oil Industry, we considered the competitive potential of proprietary extraction technology.

Control of transportation and distribution is obviously one effective competitive strategy for the upstream petroleum firm. It is in fact so effective that government regulation has had to intervene throughout the history of the industry, first with the breakup of Standard Oil and then with the regulation of gas pipeline companies.

Another effective strategy is to actively position oneself in potentially prospective areas before they have become recognized as such. Shell's early positioning in the deepwater Gulf of Mexico based on differential expectations concerning potential developments in both exploration and exploitation technology is an example of such a play.

In summary, asset owners and owners of constraining capacity will benefit most from increases in the demand for petroleum or by significant technological innovations in the upstream petroleum manufacturing industry. Competitive forces and marginal production costs will define average margins in periods of stable demand and gradual innovation.

Upstream Petroleum as a Problem Solving Industry

Now consider an alternative perspective where upstream petroleum is viewed as a problem-solving industry. With this perspective, the industry consists of firms that assist clients in solving the problem of exploring and exploiting clients' hydrocarbon resources (see Figure 11). This is the view implied by the Production Sharing Agreements that regulate revenue of the petroleum companies: The petroleum companies do not own the petroleum resources that are found and exploited, but are rather paid for their services through a combination of cost recovery oil and profit share oil. The clients are most often national governments, but can also be national petroleum companies that act as their agents.

Suppliers	Industry Competitors	Buyers
<ul style="list-style-type: none"> • Professionals • E&P Service and goods 	<ul style="list-style-type: none"> • Integrated petroleum E&P companies • Exploration shops 	<ul style="list-style-type: none"> • Owners of prospective assets

Figure 11. Upstream petroleum as a problem solving industry

Before we apply a problem solving industry perspective to upstream petroleum, let us review briefly the main characteristics of the generic problem solving industry.

Problem solving services involve the application of more or less formalized and scientific knowledge. Problem solving industries vary to the extent that they are professionalized. Professionalization implies certification and accreditation. This regulation reflects the need to protect the client in an exchange where there is potentially strong information asymmetry. Regulation also represents a barrier to entry.

There is extensive cooperation among competitors, both in terms of developing the knowledge base of the industry (profession), to promote and support effective training, and in terms of referrals. The amount of cooperation and openness will depend on the novelty of the field. A new and expanding problem domain will be the place where there is most to benefit from sharing knowledge, but where also first mover advantages are the greatest. Differentiation is the primary competitive strategy. Size becomes a means to differentiate in terms of being able to solve large problems, internalize problem recruiting and signal success.

Differentiation in the generic firm that sells problem-solving services is linked to the quality and reputation of the professionals in the firm. Problem solving services are labor intensive. Individual professionals have relatively large bargaining power. This limits profit margins for external owners. We therefore also see that problem-solving services are often organized as partnerships where the principals are producing professionals (Stabell, Fjeldstad and Sheehan, 1999).

Now consider the upstream oil and gas industry as a problem solving industry. The client is the owner of the prospective assets and the petroleum companies sell a petroleum exploration and exploitation service. Problem solving is risky as location and quantity of petroleum is most often highly uncertain. Exploration contracts are no-cure-no-pay: the petroleum company does not recover its exploration investment if the result is a dry well. However, clients also loose if they have “incompetent” service providers:

They will not get the rewards of profit oil and other taxes nor will they get the derivative economic benefits of an active petroleum industry.

Clients are typically government agencies. They will have some technical expertise (and they will engage their own experts to evaluate the “solutions” offered and/or negotiate the terms of the contract). When choosing among competitors, the client will often consider the petroleum company’s track record, ability to solve the whole problem (both exploration and exploitation of petroleum resources) and the firm’s commitment to give the problem their full attention (through exploration plans). Commitment is of such importance that it is formalized in a work program. Clients define the barriers to entry through beauty contests and bidding rounds.

Clients must however also compete for the attention of oil and gas companies. This competition is defined by the perceived prospectivity of assets, by the fiscal terms offered and by the costs of exploring and exploiting the assets.

Firms compete through differentiation, by alliances (with e.g. national oil companies), and through mergers and acquisitions. Petroleum companies try to get in before the prospectivity of assets has been proven (as discoveries can immediately change the terms offered) and try to get in position to develop a whole play should their “solution” turn out to be successful.

In frontier areas or areas with apparent low prospectivity, clients need to consider firms’ ability to promote their problem (as an opportunity) and firms’ ability to mobilize resources (partners). Promoters are an effective way to bootstrap from a less interesting problem (low prospectivity expectations) into a problem that catches the interest of the best firms in the industry.

Firms boost their competitive position through alliances, through mergers and acquisitions. Partnering is also used to spread the risk in exploration. The non-operator is then an investor, although a non-operator may also contribute important expertise.

In summary, in the problem solving industry, the network of reputations are critical. There is also a network of clients, where some are more highly valued. Different reputation classes in terms of both petroleum firms (competitors and cooperators) and in terms of asset owners (clients) form sub-groups in the industry.

Contrasting the two perspectives

Now we are ready to contrast the two perspectives. As noted, the perspectives potentially cover two different segments of upstream petroleum. Thus while the manufacturing perspective implies a sector where prospective assets are traded in a market, the problem solving service industry perspective implies a sector where ownership of prospective assets are not traded and remain in the hands of the original (national) owner.

The two industries focus different clients. They imply quite different competitive situations and competitive strategies. The manufacturing perspective focuses potential competitive advantage from differential expectations. The problem solving perspective focuses the role of reputations as a key strategic lever.

Picking up on the recent mega-mergers in the petroleum industry (that obviously involve more than upstream petroleum), how can these mergers be understood when framed in terms of the two alternative perspectives on the upstream petroleum industry?

The manufacturing perspective would seem to see both differential expectations and the ability to exploit the opportunities presented by these expectations as a driver for size. New frontiers require large investments for exploration and exploitation. They also require an ability to be able to play on expectations by acquiring a sufficient amount of prospective assets to profit from the realization of expectations.

The problem solving perspective would see size as a strong reputation signal in terms of not only ability to discover but also exploit resources.

To the extent that the different perspectives apply to different segments of upstream petroleum, one might see mega-mergers as a means to trade in assets that are not traded. Instead of being able to buy into prospective assets managed through problem solving (production sharing) contracts, firms merge with competitors so as to get a hold of their contracts.

Concluding comments

The petroleum industry is comprised of actors that represent all three value configurations with implications for both competitive strategy and the attractiveness of different segments of the industry.

Upstream petroleum represents a distinctive type of industry in terms of competitive forces and attractiveness. The basis for competitive advantage in the segments of the industry with an efficient market for trading of assets has

to be based on an ability to better sort and select assets, technological innovations and unique positions in terms of access to processing, storage, transportation and refining capacity. Where assets are allocated through a beauty contest and where asset ownership is retained by the original owner, the reputation of the actors affects their access to the best assets. Firms need to manage their reputation for competitive advantage. In the next chapter we review an empirical analysis of reputation and success in petroleum exploration.

4. Competitive Advantage in Petroleum Exploration⁹

Competitive advantage is the essence of firm performance in competitive markets. Competitive strategy is how to create and sustain competitive advantage. The literature on competitive strategy for petroleum exploration, however, is very limited. Most of the published work is on exploration strategies – choosing what plays to enter, when to get out, what to bid for a concession (see e.g. Quick and Buck, 1983, Megill, 1985). The recent focus in the literature is on composing the portfolio of exploration assets and efforts, most often in the context of both petroleum exploration and exploitation. There is much less on competitive strategy for the exploration outfit.

What might be the reasons for this lack of literature?

- Petroleum exploration is not a competition in markets with other exploration outfits, but rather a competition with Mother Nature. The effort is more cooperative than competitive as exploration outcomes can benefit others.
- Strategy for petroleum exploration is simple. It is primarily an issue of good people and good tools, and a little bit of luck.
- The large petroleum exploration outfits – the outfits that usually catch the interest of consultants and academics that publish work on competitive strategy, are not independent firms or strategic business units, but are most often functions and departments in large integrated firms.
- Modern how-to competitive strategy literature, and particularly the work of Michael Porter with his value chain framework (1980, 1985), has not been easy to apply to petroleum exploration.

We report here on research that started from the premise that Porter's value chain framework (see Figure 1) is not very easy to use when analyzing strategic positioning and competitive advantage in petroleum exploration. Our basic idea is quite simple. The value chain model is appropriate for manufacturing (think petroleum production), while petroleum exploration is primarily a problem solving service. It solves the problem of finding commercial quantities of petroleum.

⁹ This chapter builds extensively on the data and analyses reported in Sheehan (2000).

We have argued elsewhere that problem-solving services are better modeled as value shops (Stabell and Fjeldstad, 1998). In value shops (see Figure 12), the primary activity categories are problem/opportunity finding (such as focusing a new play), problem solving (generating and evaluating alternative prospects), choice (what, if any, prospect to drill), implementation (drill wildcat) and post-implementation follow-up and control (evaluating the results of wildcat). As we develop in more detail below, the distinction between value chains and value shops is not only an issue of different activity categories, but equally if not more an issue of very different business logics, different strategic drivers of performance and different strategic positioning options.

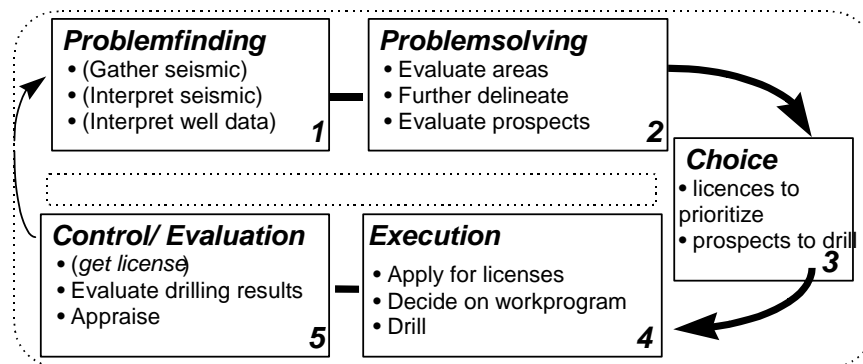


Figure 12. Value Shop Activity Template instantiated for petroleum exploration

By expanding the repertoire of models available for analyzing and developing competitive advantage, Porter's value chain framework has been transformed into value configuration theory. In what follows, we first review briefly the key idea behind value configuration theory (for more details, see Stabell and Fjeldstad, 1998). We then use the results from our survey and analysis of more than 60 exploration units operating in the UK and Norway as a means to elaborate on key aspects of a value shop perspective on petroleum. And finally we elaborate on some of the competitive strategy implications of this new perspective.

Value Configuration Theory

Value configuration theory starts from the premise that competitive advantage cannot be understood by looking at the firm as a whole. Competitive advantage stems from the many discrete activities a firm performs in generating and delivering value (Porter, 1985). Each of these activities can contribute to a firm's relative cost position and create a basis for differentiation. The theory provides a systematic basis for analyzing and developing competitive advantage. A firm is broken down into value

activities where costs and value generated are allocated and estimated, all using the value chain template for manufacturing firms and value shop template for problem solving service firms¹⁰. The results of this activity-directed review are used to identify the competitive strengths and weaknesses of the firm.

Consider a petroleum exploration shop (see Figure 12). Value activity analysis might determine that the shop is very effective in evaluating and selecting prospects to drill, but less so in terms of its ability to generate the appropriate portfolio of leads to evaluate or in following-up and learning from its wildcat drilling activities. This analysis might be based on data comparing current activities with earlier activities. Or the analysis might be based on comparing the shop with data and information from other exploration outfits in the industry.

A second order and more fundamental analysis focuses the drivers of activity cost behavior and value delivered by activities. Drivers are structural properties of activities such as scale, location, learning and timing. Drivers are also structural properties of relationships between activities in the firm and activities in other firms in the value system. An example of a structural property of the relationship between activities is how input quality assurance impacts activity rejection costs in manufacturing. Another example is how documentation activities in prospect evaluation affects value delivered by post-drilling evaluation activities.

We distinguish between cost drivers and differentiation drivers (Porter, 1985). Differentiation drivers affect the unique value delivered by the activity and thus the premium price that the customer is willing to pay. The logic of the value chain implies a focus on cost drivers, while a value shop business is more concerned about differentiation.

Again consider petroleum exploration. The distinguishing characteristic of the successful exploration outfit is not lowest costs, for example, in prospect evaluation activities or in drilling wildcats. Success is rather making significant discoveries, preferably as often as possible. Competitive strategy for exploration outfits should therefore focus differentiation drivers according to value configuration theory. But before we develop this

¹⁰ We distinguish between support and primary activities. Primary activities deliver directly value to the customer, define the business logic and vary across the 3 basic value creation technologies. Support activities affect value delivered through their effect on primary activities. Support activities support primary activities and potentially relevant for all types of firms.

argument in more detail, let us review briefly a recent survey of exploration outfits that was designed to investigate the basis for and implications of a value shop perspective on petroleum exploration.

A survey of exploration outfits

Data on exploration success for 62 exploration units active in the UK and Norway in the period 1996-1998 were obtained from secondary data sources (for more details see Sheehan, 2000). In addition, more detailed information on activities, on stakeholder evaluation of own and other exploration units, and on exploration budgets were obtained via a mail survey addressed to exploration managers. The survey was administered in June-September 1998 to the exploration managers for all exploration outfits. We obtained a response from 30 exploration units.

Exploration performance is measured with two indicators: net number of discoveries per exploration well and net reserves added per exploration well (in MMBBL OE). Size is measured using different activity indicators, but also the size of the G&G staff (See Table 4 for statistics on the exploration units sampled). We see that we sampled relatively large exploration units. The wildcat discovery rate is relatively high. A closer look at the actual distribution of net reserves per exploration well clearly has the familiar lognormal distribution, while the discovery rate is less skewed (see Figure 13 and 14).

Table 4. Descriptive statistics on exploration units sampled.

Label	Variable	AVG	MIN	MAX	N
NG&G	Size of G&G staff	27.55	2	120	31
EXBDG98	Exploration Budget 98 (MNOK)	245.33	4	1500	24
TOTWC98	Total # wildcats 96-97	3.25	0	18	24
HITRATIO9697	Discoveries/wildcat 96-97	0.44	0	1	24
RESERVINC/WC	Reserve increase pr wildcat 96-97	10.36	0	83.72	22

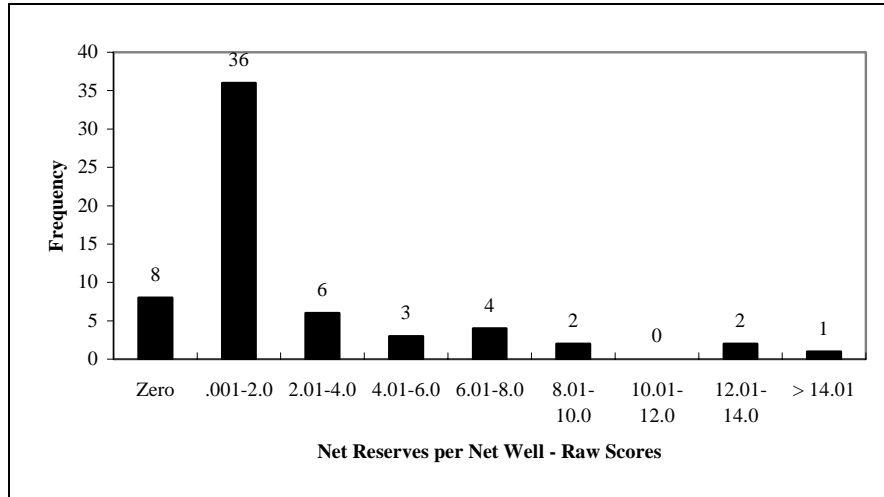


Figure 13. Net Reserves per Net Well (N=62)

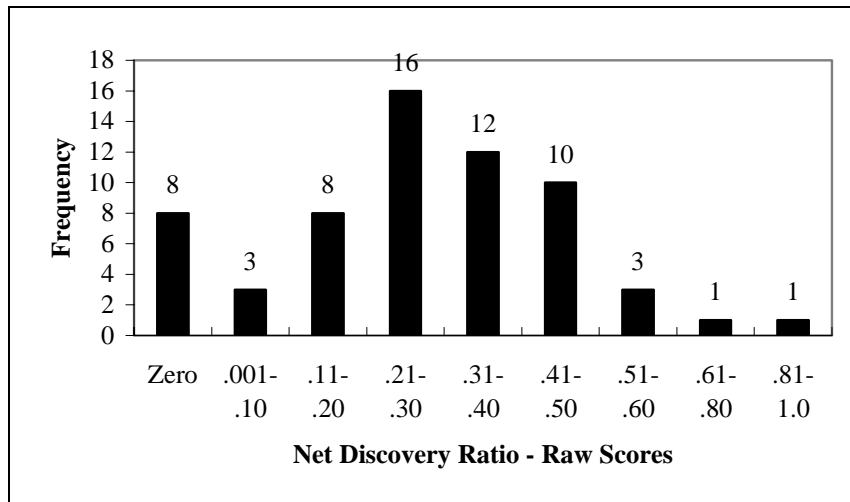


Figure 14. Net Discovery Ratio (N=62)

The exploration shop

We can now review in more detail some of the distinctive aspects of the value creation logic (and thus business logic) of exploration shops.

Let us start by noting that if we were to apply a value chain logic to exploration shops, then one might argue that the exploration input are leads

and the exploration output are discoveries¹¹. This simple articulation ignores that getting good leads is key and that not all leads are drilled, nor do they always produce discoveries! In short, the process is not one of transformation, but rather one of selection, screening and sorting. This is also evident from the data in our sample.

Table 5 The Exploration Project Funnel

	Mean	Min	Max	N
Number of discoveries (1998)	1.25	0	5	20
Number of exploration wells (1998)	4.05	0	17	20
Number of prospects in inventory	29.06	2	250	24
Number of leads in inventory	73.13	0	500	24
Number of prospects per G&G staff	1.29	0.13	5	24

Table 5 shows key activity statistics in terms of average number of leads, number of prospects, number of wildcats and number of discoveries (see also Figure 15). There is clearly a narrowing of focus where on the average 73 leads are pruned to 29 prospects, 29 prospects are pruned to 4 wildcats and 1 out 4 wildcats are discoveries. Not surprising, the strongest pruning is from prospects to exploration wells as it is the drilling decision that commits significant funds and attention.

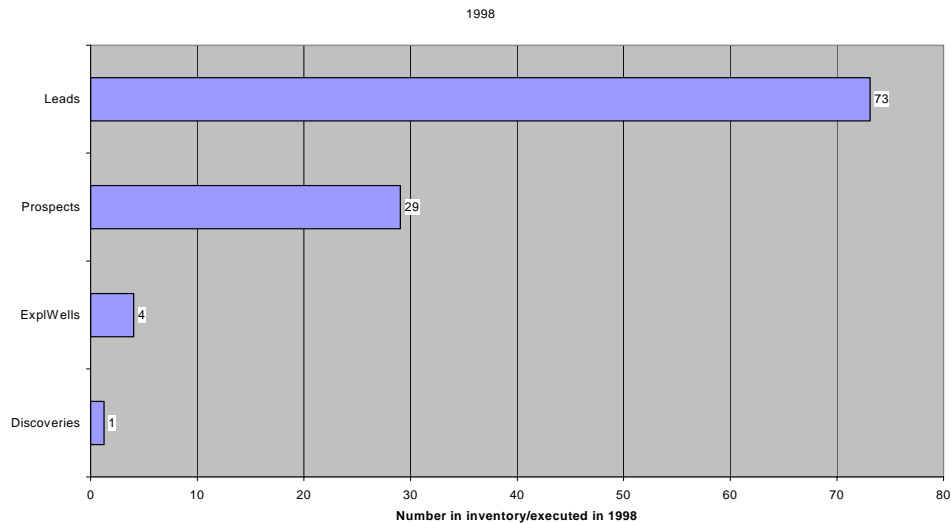


Figure 15. The Exploration Project Funnel

¹¹ An alternative chain formulation is that the input is data and the output is proven resources in the ground.

The screening, pruning and sorting of problems and opportunities implies that the basic unit of production – such as number of discoveries, is in general not a very meaningful measure of activity levels in an exploration shop. It is more appropriate to use some measure of project load relative to both capacity and the exploration funnel. One relative load measure is the number of prospects per G&G staff (see Table 5).

So what are the other implications of looking at petroleum exploration as a value shop?

A key point is the relative strategic and competitive importance of the different value activities. Management focus and professional attention in an exploration department is often on problem solving activities (delineating and evaluating prospects) and implementation activities (drilling) as this is where most of the exploration costs are incurred. Figure 16 shows an estimate of the relative composition of exploration costs (using average figures for the 30 exploration outfits sampled with the mail survey). The figure illustrates the relative cost importance of particularly execution activities (drilling). The main value creating activities, however, are probably problem finding and learning from post-drilling evaluation.

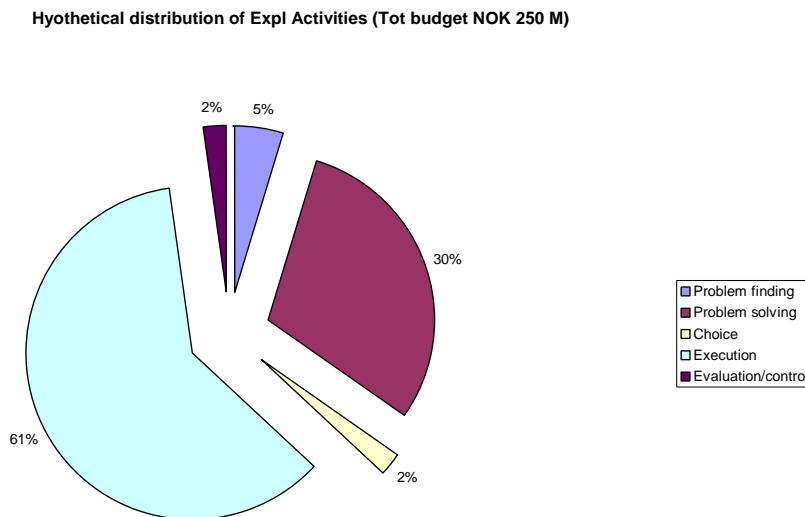


Figure 16. Hypothetical Distribution of Exploration Budget Across Activities

Another related implication of a value shop perspective is the relative importance of cost drivers and differentiation drivers.

Scale and capacity utilization are often used to illustrate the concept of drivers. In manufacturing (value chains) these are generally key drivers of cost: Unit costs drop with scale and capacity utilization. In value shops, however, costs are often secondary to the issue of solving the client's problem. In the shop we are more concerned about value – healing the patient, winning the case, finding hydrocarbons, and thus differentiation drivers. Or restated in petroleum exploration terms, it costs about the same effort to make a large discovery as one that is barely commercial.

What are the critical differentiation drivers in petroleum exploration?

Our survey asked exploration managers what they considered were the critical success factors for achieving and maintaining a high performance exploration outfit. Their answers suggested three main categories of success factors: assets, management support, and people. These three categories covered over 85% of the factors identified. The most popular category was one that we labeled, 'assets': leading edge technology, a good portfolio of licenses, and a creative culture and good knowledge base. The second most popular factor was 'management support'. Under this category respondents' comments included predictable funding, willingness to take risks, consistent strategy and focus, and short decision time. The third most frequent response was 'people' as a key success factor, with comments such as competent, knowledgeable and motivated staff.

The management factor can be interpreted as having supportive clients as most of the respondents were responsible for exploration in integrated petroleum exploration and production firms.

But how is the exploration shop to get the best acreage, the best people and solid client (management) support? Value configuration theory argues that it is by being successful. This brings us to what we argue is the critical differentiation driver in value shops: reputation.

Reputation is critical in value shops because of the basic information asymmetry that is built into the relationship between the shop and its clients. Clients consult a shop precisely because the client believes that the shop knows how to solve the client's problem. The client consults the shop because the shop knows something that the client does not know.

The client needs to be sure that the shop makes a best effort at using their specialized knowledge. Success signals not only expertise, but also commitment.

Success drives reputation. But reputation also drives success as good reputation gives access not only to the best projects, but also to the best personnel. Over time there is a positive feedback loop where success gives access to the best projects (acreage and prospects) and also attracts the best professionals (see Figure 17). In short, success and reputation lead to the accumulation of the assets and competences that ensure future success.

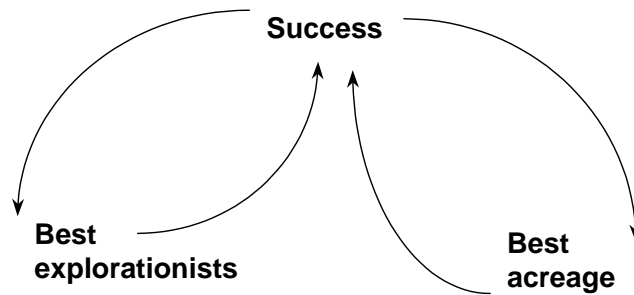


Figure 17. The positive success feedback loop in exploration

There can be different sources of reputation and different types of reputation: a reputation for having the best people, the best activities, but most important the best results in terms of success. For the exploration shop, the critical result is the discovery rate and reserves per exploration well. These are clear and public results.

However, active professional involvement in professional forums is also a means to manage reputation. Exposure through alliances and partnerships is another source for not only signaling success, but also of managing reputation capital.

Reputation and Exploration Success

In our survey we asked each exploration manager sampled to identify the three leading exploration outfits respectively in the UK and in Norway. The results were weighted according to whether an outfit was listed first, second or third. Figure 18 shows the reputation score distribution over the whole sample of 62 units in the UK and Norway while Table 6 shows the top 3 exploration outfits in respectively the UK and Norway.

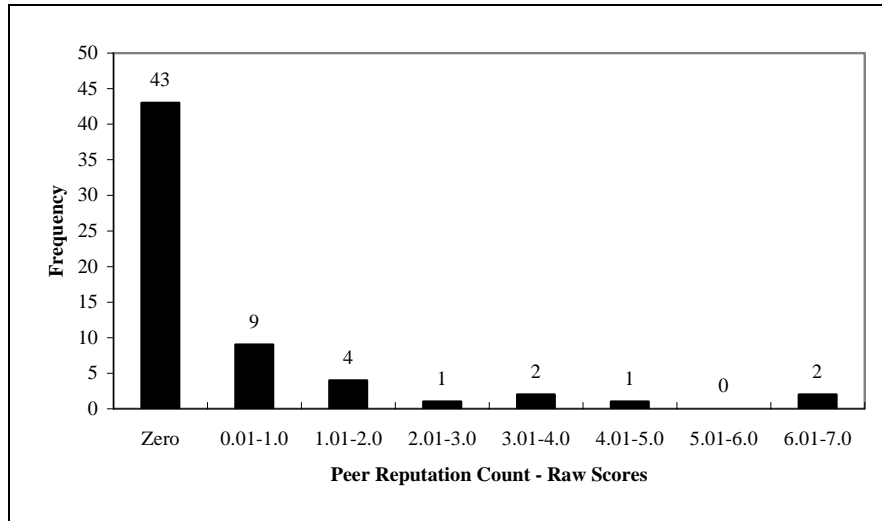


Figure 18. Peer Exploration Shop Reputation Score (N=62)

As is apparent from the reputation score distribution, reputation is very unevenly distributed. The distribution underlines the potential strategic importance of reputation.

Table 6. Top ranked exploration outfits in UK and Norway (1998)

Country	Exploration Outfit	Reputation Score
UK	Amerada Hess	6.8
	Shell	3.8
	Conoco	2.1
Norway	Enterprise	6.9
	Mobil	5.1
	Norsk Hydro	3.3

Our data supports the proposition that there is a positive link between reputation and success as measured by discovery ratio and net reserves per exploration well¹². This result holds even when controlling for size. In other words, the link between reputation and exploration success is not just capturing that the larger exploration units are better known. The list with the ranking of the top exploration outfits in each country (see Table 6) is

¹² The relationship is statistically significant for the sample of exploration outfits in operating in Norway, but not so for the UK exploration outfits. For more details see Sheehan, 2000.

consistent with this finding. For example, Enterprise is not the largest exploration outfit in Norway.

At this point in time we cannot show statistically that high reputation drives *future exploration success*. However, as we have developed above, there are many arguments that support this proposition. The driver effect of reputation would appear to be particularly apparent in settings where access to acreage is based on a “beauty contest”. But more generally, exploration shops with the best reputation get a first look at the best prospects, they are often the preferred partners and they attract the best professionals.

Managing success becomes critical for exploration outfit performance. This is true irrespective of whether the exploration shop is an independent firm (a prospect generator), a strategic business unit or a function in an integrated petroleum E&P firm.

What are some of the other implications that come from viewing petroleum exploration as a value shop? We think that there are many. They pertain to issues such as:

- What kind of exploration business to be in?
- How to configure the activity portfolio?
- The role of scale in exploration?
- The role of location and learning?
- The sourcing of ideas (leads).
- The role of learning?

We focus on configuring the project portfolio as this provides a direct link to strategic positioning in terms of differentiation drivers.

Configuring the activity portfolio?

Positioning of activities must be relative to both opportunities and other exploration shops. Table 7 shows some key statistics from our survey of activity configuring: share of prospects in frontier areas, share of prospects generated internally, and share of prospects in other’s acreage.

Table 7. Strategic Positioning Indicators of Exploration Projects

	Mean	Min	Max	N
% of prospects in Frontier Plays	20%	0%	80%	24
% of prospects Internally generated	65%	20%	100%	24
% prospects in own licence areas	68%	20%	100%	24

A prospect can be viewed as a project in an exploration shop. As noted earlier, projects are the relevant activity level indicator in shops. They compare to production volume in manufacturing. Exploration shops handle exploration projects.

The percentage of prospects in frontier plays (plays where the presence of hydrocarbons remains to be proven) indicates both the maturity of the exploration province and the strategic positioning of the exploration shops serving in the province. The low average percentage of prospects in frontier plays is consistent with the view of the UK and Norway as relatively mature exploration provinces. Still, there are some exploration shops that have as much as 80% of their exploration activity focused on frontier plays.

The percentage of prospects internally generated reflects the amount of problem and opportunity trading between exploration shops. On the average, more than 50% of the prospects considered were generated internally. Low internal generation might reflect that the shop is really a “partner” considering the prospects proposed by other exploration shops. It could, however, be an indication that the exploration shop is actively approached by a large number of other firms and thus has expanded the reach of its exploration effort. We see an analog to this situation in the pharmaceutical industry where external shops and research institutes are a major source of creative ideas. The critical issue is whether the shop gets first look or only gets to see prospects that have been worked over by more attractive partners.

The percentage of prospects in own license area is another measure of how the exploration shop scans the opportunity frontier, both to actively manage acquisition of externally generated prospects and to learn from the efforts of other exploration outfits. Exploring in areas where the shop does not have a license is potentially not very rewarding as license ownership is a prerequisite for appropriating a significant share of the value of exploration activities.

Petroleum exploration has much in common with research in other industries. One of the important messages from management of R&D is the development strategy framework (Clark and Wheelwright, 1993) with the notion of a portfolio of breakthrough, platform and derivative development projects.

The development strategy framework underlines the strategic role of plays as pivotal elements in strategy for exploration outfits: Establishing a new play from both an exploration and exploitation perspective can be understood as a platform project. Breakthrough projects are in frontier areas, while

derivatives are stepping out in an established play. Our prospect portfolio statistics can directly be interpreted in terms as reflecting a strategic positioning of the exploration shop. What is lacking from the structural statistics, however, is the quality of the portfolio. And here we again link to the critical role of reputation.

Conclusion

Value configuration theory provides a new framework for the analysis of competitive advantage in petroleum exploration. The theory establishes a clear link between modern competitive strategy and petroleum exploration. Not surprisingly, the framework also refocuses established concepts in exploration strategy. But it also clearly demonstrates the critical role of reputation as a key differentiation driver and determinant of long-term success. It also suggests the role of both problem (opportunity) finding and post-drilling evaluation as two critical levers for competitive success in petroleum exploration.

By linking exploration to the whole literature on strategy for R&D value configuration theory also expands the repertoire of experiences and approaches that can be used to develop competitive advantage. Even though petroleum exploration is to a large extent competing against nature, there are also clearly significant arenas for competition and cooperation.

5. Summary and conclusions

This project was started up as an effort focused on the petroleum industry and designed to further develop, test and apply new models for value creation and competitive advantage that were initially proposed by Fjeldstad and Stabell in 1995 (see Stabell and Fjeldstad, 1998).

The basic idea behind the project was that Porter's value chain model (1985) for the analysis of firm-level competitive advantage was basically only applicable to manufacturing. Building on Thompson's (1967) distinction between long-linked, intensive and mediating value creation technologies, we proposed three distinct generic value configurations for the analysis and management of firm-level value creation across industries and firms. Each configuration has a distinct activity template and different drivers of firm performance. Thus, while the value chain is proposed as relevant to the analysis of manufacturing firms relying on a long-linked technology, the value shop is an activity template for firms that use an intensive technology and create value by resolving unique customer problems. The value network is an activity template for firms that use a mediating technology and that create value by enabling direct and indirect exchanges across a set of customers.

The major results of the work can be grouped into three main areas: further development of theories and methods, empirical studies, and impact on research, teaching and practice. While our empirical studies are focused on the petroleum industry (primarily petroleum exploration), the other categories of results span a much broader range of issues and industries.

The work has already spawned significant work both nationally and internationally. The best national example is the work on A Value Creating Norway (see Jakobsen et al, 2000). This study presents an innovative analysis of clusters integrating the Porter Diamond (1990) and value configuration theory. The telecom industry has been another sector for theory development and application (Fjeldstad, 1999). A recent international textbook (Afuah and Tucci, 2000) has value configuration theory as a pivotal element in the analysis of strategy for the new Internet economy.

Our work has had to contain a significant dose of model and concept development. Simply stated, the value chain concepts turned out to be less articulated and less easy to operationalize than initially envisaged. In part this is due to that the value chain concept is mainly a very broad, generic

framework that had as one key hallmark that it has been designed to be applicable to all industries and all firms.

Initially the ideas were developed for the firm-level analysis. In three different analyses of respectively downstream gas, the heavy oil industry and the upstream petroleum industry on the Norwegian Continental Shelf we show that the concepts of industry analysis also need to be revised and adjusted.

The complete set of models and methods for the analysis of competitive strategy and competitive advantage define what we now label as value configuration theory. Value configuration theory builds on and extends Porter's initial work on competitive strategy and competitive advantage (1980, 1985). Our work in this project and related work in other sectors has clarified the need to consider industry analysis (Porter, 1980) and firm analysis (Porter, 1985) as two highly interrelated issues. Industry structure mirrors value creation logic. Recognizing alternative value configurations has triggered an understanding of the existence of different competitive logics in respectively manufacturing, mediation and problem solving service industries. Application of value configuration theory to the petroleum industry has focused and stimulated efforts to further clarify key concepts. Much work remains to be done, but we note already the need to look at how referral, partnering and interconnection networks structures competition and cooperation in mediation and problem solving service industries. Other main conceptual results are:

- Value configuration must be linked to the business (revenue) model. Our initial ideas concerning hybrid configurations should rather be interpreted as forming the basis for analysis of corporations. Each business unit has a distinct value configuration. To the extent that strategic business units do not focus a primary value configuration then effective strategic positioning is difficult to achieve.
- The concept of drivers is at the core of value configuration theory. Porter's (1985) initial formulation is comprehensive from an application perspective, but conceptually not very well defined. We propose that drivers be defined as structural properties of activities (or the relationship between activities) that shape activity level cost behavior and differentiation contributions (Sheehan, 2000). Drivers need to be activity focused and effective strategic positioning requires considering the interplay of multiple drivers. A main point for value configuration theory is that the relative importance of and relationship between drivers varies systematically across value configurations.

The central empirical effort of the project has been a detailed study of reputation as a differentiation driver in petroleum exploration shops (Sheehan, 2000). Exploration is framed as a value shop that solves the “problem” of finding commercial quantities of petroleum. Exploring the hypothesis that reputation is a key driver of differentiation in value shops, the study develops key contributions in terms of both the theory (see above) and its application to petroleum exploration. The empirical results using data from 62 North Sea exploration units (40 in the UK and 22 in Norway) support the hypothesized relationship between reputation and performance. This result holds even when controlling for size. Data collected as part of the study provides a rich backdrop and benchmark both for further research and for application of value configuration analysis to petroleum exploration.

The data from our study of exploration shops also provides an excellent reference for the analysis of other value shops in both the petroleum industry and other sectors. At the same time petroleum exploration is a particular type of value shop in the sense that appropriation of a significant share of the value created requires that the shop own the acreage where petroleum is found. Governance structures and the organization of petroleum exploration as a business unit is therefore also not common among the dominant players in the upstream petroleum industry. Most of the exploration outfits sampled in our study were organized as support activities relative to the primary business model related to the sale of petroleum products.

Our work has had the global petroleum industry as its application focus. This industry provides a rich and in many ways a complex setting for developing and analyzing the implications of the distinction between the different value configurations.

We show that one can take two perspectives on the different segment of the upstream petroleum industry – with important implications for strategy. We consider two views. In the first, upstream petroleum E&P is an industry of petroleum producers (i.e. a manufacturing industry), where prospective assets are traded freely. The alternative view is that upstream E&P is a problem solving industry, where petroleum E&P companies are solving the problem of finding and exploiting petroleum resources for the asset owner (typically national governments). In the one case, firms generate their revenue from the sale of petroleum. In the other case the petroleum E&P firms are paid for their exploration and exploitation service (most often in petroleum) to the asset owners. We argue that competitive advantage in the manufacturing industry with efficient markets both for petroleum assets and petroleum at the well head is based on differential expectations.

Competitive advantage in petroleum E&P as a problem solving service industry is based on reputation.

One can ask so what? What are the implications of considering the petroleum industry as populated by firms with distinct value creation logics?

The work has significant implications for issues such as effectiveness, alliances and internationalization. The simplest is that we need to differentiate approaches and strategies across sectors according to what type of sector or where the sector is situated in the larger value system. Equally important, tools for analysis of both firms and industries are strongly interrelated.

There is both good news and bad news for applied strategy analysis.

The good news is that there are a finite number of alternative models to consider. Briefly stated, we still believe that there are only 3 basic models with associated activity templates: the value chain, the value shop and the value network.

The bad news is that analysis for competitive advantage is not necessarily much easier. Although the alternative activity models provide a good basis for a first order understanding of value creation and business logics, effective application is challenging. This should not be a surprise, as effective strategy cannot be easy to define and achieve as the strategy otherwise would be easy to imitate.

One of the requirements for effective application is that we need a rich repertoire of benchmark templates that can help bootstrap analyses and assist in interpreting results. Our empirical work on petroleum exploration in particular provides a first systematic basis for this type of work in petroleum exploration.

Perhaps most promising in terms of results is that we have identified a broad range of issues for further research. Many are commented on in the different chapters of this report and in the underlying research reports. Among the more important issues that relate to petroleum exploration, we propose that there is need for research that documents the dynamics of differentiation drivers. Our work has documented the link between exploration success and reputation. We need more empirical work to understand how reputation affects future performance. As a result of our work this research can start from a sounder conceptualization and measurement basis for both reputation and exploration success.

We have suggested that firm and industry analysis are interrelated. There is a significant need for more research on improving the models and methods for the analysis of problem solving and mediation industries. And value configuration theory needs to be developed so that it also covers corporate strategy in settings where corporations can be composed of business units that are homogenous and a heterogeneous in terms of types of value creation technology.

The ideas that formed the platform for this research project evolved from efforts to analyze and understand competitive strategy and competitive advantage across a broad range of industries and firms. Our experience suggests that such a broad and comparative perspective is important for further work. One promising avenue for future research would be a comparative analysis of R&D shops across several industries, for example comparing petroleum exploration and development with research and development in the pharmaceutical industry. Such work can possibly give an even better understanding of the unique attributes of the petroleum sector. It should also provide better models and methods for strategy in activities that are critical in innovative sectors of the modern economy.

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